Attorney Docket No. 291958170US2 Semitool Ref No. P99-0006US3

I hereby certify that this correspondence is being deposited with the U.S. Postal Service with sufficient postage as First Class Mail in an envelope addressed to: Commissioner for Patents, Washington, D.C., 20231 on: 33, 3003 Date: PATENT IN THE UNITED STATES PATENT AND TRADEMARK OFFICE CONFIRMATION No. 3390 IN RE APPLICATION OF: **ART UNIT: 1741** THOMAS L. RITZDORF ET AL. **APPLICATION No.: 09/885,451** FILED: JUNE 20, 2001 FOR: METHOD AND APPARATUS FOR LOW TEMPERATURE ANNEALING OF METALLIZATION MICRO-STRUCTURES IN THE PRODUCTION OF A MICROELECTRONIC DEVICE Information Disclosure Statement Within Three Months of Application Filing or Before First Action – 37 CFR 1.97(b) Commissioner for Patents Washington, D.C. 20231 Sir: Timing of Submission 1. This information disclosure is being filed within three months of the filing date of this application or date of entry into the national stage of an international application or before the mailing date of a first Office action on the merits, whichever occurs last [37 CFR 1.97(b)]. The references listed on the enclosed Form PTO-1449 (modified) may be material to the examination of this application; the Examiner is requested to make them of record in the application. Cited Information 2. Copies of the following references are enclosed: \boxtimes All cited references References marked by asterisks The following: \boxtimes

AHN, E. C. et al. "Adhesion Reliability of Cu-Cr Alloy Films to Polyimide" Materials Research Society Symposium Proceedings, 1996, Vol. 427, pp. 141-145, Materials Research Society.

ALERS, G. B. et al. "Trade-off between reliability and post-CMP defects during recrystallization anneal for copper damascene interconnects" *IEEE International Reliability Physics Symposium*, 2001, pp. 350-354.

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GLADKIKH, A. et al. "Activation Energy of Electromigration in Copper Thin Film Conductor Lines" *Materials Research Society Symposium Proceedings*, 1996, Vol. 427, pp. 121-126, Materials Research Society.

KONONENKO, O. V. et al. "Electromigration In Submicron Wide Copper Lines" Materials Research Society Symposium Proceedings, 1996, Vol. 427, pp. 127-132, Materials Research Society.

MEI, Y. et al. "Thermal Stability and Interaction Between SIOF and Cu Film" Materials Research Society Symposium Proceedings, 1996, Vol. 427, pp. 433-439, Materials Research Society.

RUSSELL, S. W. et al. "The Effect of Copper on the Titanium-Silicon Dioxide Reaction and the Implications for Self-Encapsulating, Self-Adhering Metallization Lines", *Materials Research Society Symposium Proceedings*, 1992, Vol. 260, pp. 763-768, Materials Research Society, Pittsburgh, PA.

Ø 09/018,783:	Copies of the following references can be found in parent application Ser. No.
	 □ All cited references ☑ References marked by asterisks □ The following:
	The following references are not in English. For each such reference, the undersigned has enclosed (i) a translation of the reference; (ii) a copy of a communication from a foreign patent office or International Searching Authority citing the reference, (iii) a copy of a reference which appears to be an English-language counterpart, or (iv) an English-language abstract for the reference prepared by a third party. Applicant has not verified that the translation, English-language counterpart or third-party abstract is an accurate representation of the teachings of the non-English reference, though, and reserves the right to demonstrate otherwise.
	 ☐ All cited references ☐ References marked by ampersands ☐ The following:

3. Effect of Information Disclosure Statement (37 CFR 1.97(h))

This Information Disclosure Statement is not to be construed as a representation that: (i) a search has been made; (ii) additional information material to the examination of this application does not exist; (iii) the information, protocols, results and the like reported by third parties are accurate or enabling; or (iv) the cited information is, or is considered to be, material to patentability. In addition, applicant does not admit that any enclosed item of information constitutes prior art to the subject invention and specifically reserves the right to demonstrate that any such reference is not prior art.

4. Fee Payment

No fees are believed due. However, should the Commissioner determine that fees are due in order for this Information Disclosure Statement to be considered, the Commissioner is hereby authorized to charge such fees to Deposit Account No. 50-0665.

5. Patent Term Adjustment (37 CFR 1.704(d))

The undersigned states that each item of information submitted herewith was cited in a communication from a foreign patent office in a counterpart application and that this communication was not received by any individual designated in 37 C.F.R. § 1.56(c) more than thirty days prior to the filing of this statement. 37 C.F.R. § 1.704(d).

Respectfully submitted,

Perkins Coie LLP

Date: 22 Nov 02

Edward S. Hotchkiss Registration No. 33,904

Correspondence Address:

Customer No. 25096 Perkins Coie LLP P.O. Box 1247 Seattle, Washington 98111-1247

Phone: (206) 583-8888

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	U.S. PATENT DOCUMENTS					
Examiner Initials	U.S. Patent or Application Cite Kind Code No. NUMBER (if known)			Name of Patentee or Inventor of Cited Document	Date of Publication or Filing Date of Cited Document	Pages, Columns, Lines, Where Relevant Figures Appear
		*2,443,599		Allen E Chester	06/22/48	
		*3,894,918		Corby et al.	07/15/75	
		*4,250,004		Miles et al.	02/10/81	
		*4,539,222		Anderson, Jr. et al.	09/03/85	
		*4,687,552		Early et al.	08/18/87	
		*4,891,069		Holtzman et al.	01/02/90	
		*5,164,332		Kumar	11/17/92	
		*5,314,756		Tagaya	05/24/94	
		*5,431,803		DiFranco et al.	07/11/95	
		*5,600,532		Michiya et al.	02/04/97	
		*5,605,615		Goolsby et al.	02/25/97	
		*5,612,254		Mu et al.	03/18/97	
		*5,627,102		Shinriki et al.	05/06/97	
		*5,893,752		Zhang et al	04/13/99	
		*5,939,788		McTeer	08/17/99	
		*5,969,422		Ting et al.	10/19/99	
		*5,972,192		Dubin et al.	10/26/99	
		*6,001,730		Farkas et al.	12/14/99	
		*6,043,153		Nogami et al.	03/28/00	
		*6,074,544		Reid et al.	06/13/00	
		*6,082,163		Armstrong et al.	06/06/00	
		*6,126,761		DeHaven et al.	10/03/00	
		*6,228,768		Woo et al.	05/08/01	1.0
		*6,254,758		Koyama	07/03/01	19/2
		*6,278,089		Young et al.	08/21/01	CE JUN
		*6,280,183		Mayur et al.	08/28/01	10 m

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		EP	*0 751 567 A		Intl. Business Machines Co	orp.	01/02		Appear	+
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		*NGU	YEN et al, "Inter c	onnect	and Contact Metallization," Ried, F t, PV 97-31, The Electrochemical	H. ar	d Ratho	re. G.S.	Mathan, C.	
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Sheet	3	of	6	Attorney Docket No.	29195-8170US2	

		OTHER PRIOR ART-NON PATENT LITERATURE DOCUMENTS	
Examiner Initials	Cite No.	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume issue number(s), publisher, city and/or country where published.	т
		*FOULKE, D.G., in "Gold Plating Technology," Reid, F.H. and Goldie, W., p 67, Electrochemical Publication Ltd, British Isle (1996).	
		*TOMOV, V., STOYCHEV. D.S., VITANOVA, I.B., "Recovery And Recrystallization Of Electrodeposited Bright Copper Coatings At Room Temperature. II. X-Ray Investigation Of Primary Recrystallization,", Journal of Applied Electrochemistry, 15, 887-894. Chapman and Hall Ltd. (1985).	
		*STOYCHEV. D.S., TOMOV, V., VITANOVA, I.B., "Recovery And Recrystallization Of Electrodeposited Bright Copper Coatings At Room Temperature. I Microhardness in relation to Coating Structure", <i>Journal of Applied Electrochemistry</i> , 15, 879-886. Chapman and Hall Ltd. (1985).	
		*RITZDORF, T., GRAHAM, L., JIN, S., MU, C. and FRASER, D., "Self-Annealing of Electrochemically Deposited Copper Films in Advanced Interconnect Applications," Proceedings of the IEEE 1998 International Interconnect Technology Conference, San Francisco, CA (June 1-3, 1998).	
		*DUBIN, V.M., SHACHAM-DIAMAND, Y., ZHAO, B., VASUDEV, P.K. and TING, C.H., "Sub-Half Micron Electroless Cu Metallization," Materials Research Society Symposium Proceedings, Vol. 427, San Francisco, (1996).	
		*COOK, M. and RICHARDS, T., "The Self-Annealing of Copper," J. Inst. Metals, vol. LXX, pp. 159-173 (1943).	
)	D	*MAK, C.Y., "Electroless Copper Deposition on Metals and Metal Silicides," Materials Research Society Bulletin, (August 1994).	
2 2002	0 1	*HOGAN, B.M., "Microstructural Stability of Copper Electroplate," (citation unknown but believed to be published more than one year before the date of this patent application).	
DEC 0		*STOYCHEV, D., VITANOVA, I. VIEWEGER, U., "Influence of the Inclusions in Thick Copper Coatings on Their Physico – Mechanical Properties," (citation unknown but believed to be published more than one year before the date of this patent application).	
		*STOYCHEV, D.S., and AROYO, M.S., 'The Influence of Pulse Frequency on the Hardness of Bright Copper Electrodeposits," <i>Plating & Surface Finishing</i> , pp. 26-28 (August 1997).	
		*STOYCHEV, D.S., and AROYO, M.S., 'On the Influence of Pulse Frequency on the Hardness of Bright Copper Electrodeposits, (citation unknown but believed to be published more than one year before the date of this patent application).	
		*STEIN, B., "A Practical Guide to Understanding, Measuring and Controlling Stress in Electroformed Metals," presented at the AESF Electroforming Symposium, Las Vegas, NV (March 1996).	

EXAMINER		DATE CONSIDERED
*EXAMINER:		nce with MPEP 609. Draw line through citation if not in conformance and not
	considered. Include copy of this form with next communication to a	pplication(s).



INFORMATION DISCLOSURE STATEMENT BY APPLICANT

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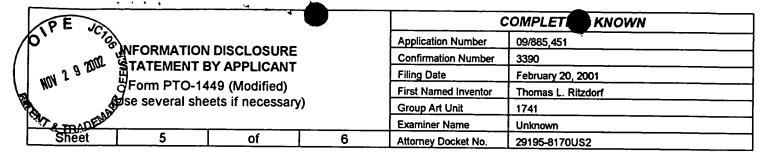
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	First Named Inventor	Thomas L. Ritzdorf
	Group Art Unit	1741
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	Attorney Docket No.	29195-8170US2

		OTHER PRIOR ART-NON PATENT LITERATURE DOCUMENTS	_
Examiner Initials	Cite No.	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume issue number(s), publisher, city and/or country where published.	_1
		*SANCHEZ, J. JR., BESSER, P.R., and FIELD, D.P., "Microstructure of Damascene Processed Al-Cu Interconnects for Integrated Circuit Applications," presented at the Fourth International Workshop on Stress Induced Phenomena in Metallizations, Tokyo, Japan (June 1997).	
		*SANCHEZ, J. JR. and BESSER, P.R., "Modelling Microstructure Development in Trench- Interconnect Structures," Proceedings of the IEEE 1998 International Interconnect Technology Conference, Sunnyvale, CA. (June 1998).	
		*FIELD, D.P., SANCHEZ, J. JR., BESSER, P.R., DINGLEY, D.J., "Analysis of Grain-Boundary Structure in Al-Cu Interconnects," <i>J. Appl., Phys.,</i> 82(5) (September 1, 1997).	
		*GUPTA, D., "Comparative Cu Diffusion Studies in Advanced Metallizations of Cu and Al-Cu Based Thin Films," Materials Research Society Symposium Proceedings, San Francisco, CA (April 1994).	
		*MEGAW, H.D. and STOKES, A.R., "Breadths of X-Ray Diffraction Lines and Mechanical Properties of Some Cold-Worked Metals," <i>J. Inst. Metals</i> , vol. LXXI, pp. 279-289 (1944)	
25	9	*THOMPSON, C.V., and KNOWLTON, B.D., "Designing Circuits and Processes to Optimize Performance and Reliability: Metallurgy Meets Tcad," <i>Microelectronics and Reliability</i> , 36, P. 1683 (1996).	
0 2 2002	170	*CAREL, R., THOMPSON, C.V., FROST, H.J., <i>Material Research Society Symposium</i> , Vol. 343, Materials Research Society (1994).	
OEC	2	*FLORO, J.A., CAREL, R. and THOMPSON, C.V., "Energy Minimization During Epitaxial Grain Growth: Strain vs. Interfacial Energy," <i>Material Research Society Symposium</i> , Vol. 317, Materials Research Society, (1994).	
		*PLÖTNER, M., URBANSKY, N., PREUSZ, A. and WENZEL, C., "Control of Mechanical Stresses and their Temperature Dependence in PVD CU Films," presented at Adv. Metalliz. & Interconn. Syst. ULS Applic. San Diego (1997).	
		*WONG, CHEE. C., SMITH, H.I., and THOMPSON, C.V., "Secondary Grain Growth and Graphoepitaxy in Thin Au Films on Submicrometer-Period Gratings," <i>Material Research Society Symposium Proc</i> , Vol. 47, Materials Research Society (1985).	
		*THOMPSON, C.V., and SMITH, H.I., "Secondary Grain Growth in Thin Films." <i>Material Research Society Symposium Proc.</i> , Vol. 57, Materials Research Society (1987).	

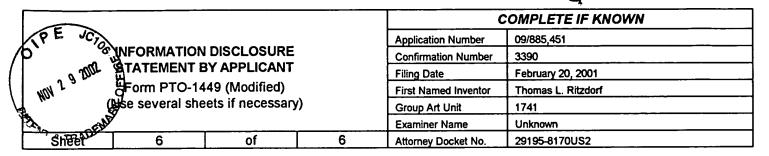
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*EXAMINER: Initial if reference considered, whether or not criteria is in conform	ance with MPEP 609. Draw line through citation if not in conformance and not application(s).



	OTHER PRIOR ART-NON PATENT LITERATURE DOCUMENTS						
Examiner Initials	Cite No.	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume issue number(s), publisher, city and/or country where published.	т				
		*WONG, C.C., SMITH, H.I., and THOMPSON, C.V., "Room Temperature Grain Growth in Thin Au Films, from <i>Grain Boundary Structure and Related Phenomena</i> , supplement to <i>Transactions of Japanese Institute of Metals</i> , 27, p. 641 (1986).					
		*THOMPSON, C.V., "Observations of Grain Growth in Thin Films," from <i>Microstructural Science for Thin Film Metalizations in Electronics Applications</i> , eds. J. Sanchez, D.A. Smith and N. DeLanerolle, The Minerals, Metals & Materials Society (1988).					
		*FROST, H.J., THOMPSON, C.V., and WALTON, D.T., "Abnormal Grain Growth in Thin Films Due to Anisotropy of Free-Surface Energies," <i>Materials Science Forum</i> , Vols. 94-96, pp. 543-550, Trans Tech Publications, Switzerland (1992).					
		*FROST, H.J. and THOMPSON, C.V., "Microstructural Evolution in Thin Films," presented at the Symposium on Computer Simulation of Microstructural Evolution, Toronto, Canada, October 15 (1985).					
		*FROST, H.J. THOMPSON, C.V., and WALTON, D.T., "Grain Growth Stagnation and Abnormal Grain Growth in Thin Films," presented at TMS-AIME Fall Meeting, Indianapolis, IN (1989).					
		*REED-HALL, et al., "Physical Metallurgy Principles," pp. 270, 286 and 287, 83 rd Ed. (1991).					
		*FROST, H.J. and THOMPSON, C.V., "Modeling of Optical Thin Films," reprint from Proceedings of SPIE (International Society for Optical Engineering, San Diego, CA 1987, printed by the Society of Photo-Optical Instrumentation Engineers (1988).					
		*WALTON, D.T., FROST, H.J. and THOMPSON, C.V., "Computer Simulation of Grain Growth in Thin-Film Interconnect Lines," Mat. Res. Soc. Symp. Proc., vol. 225 (1991).					
		*Harper, J.M.E., Rodbell, K.P., "Microstructure control in semiconductor metallization", <i>J. Vac. Sci. Technol.</i> B 15(4), pp. 763-779, Jul/Aug 1997.					
		*Gangulee, A., "The Structure of Electroplated and Vapor-Deposited Copper Films", <i>J. Appl. Phys.</i> , Vol. 43, No. 3, pp. 867-873, March 1972.	_				
		*Gangulee, A., "Structure of Electroplated and Vapor-Deposited Copper Films III. Recrystallization and Grain Growth", <i>J. Appl. Phys.</i> , Vol. 45, No. 9, pp. 3749-3756, September 1974.					
		*Gross, M.E. et al, "Microstructure and Texture of Electroplated Copper in Damascene Structures", Material Research Society Proceedings, Vol. 514, 1998.					

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Examiner Initials	Cite No.	(book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume issue number(s), publisher, city and/or country where published.	Т
		*Edelstein, D. et al, "Full Copper Wiring in a Sub-0.25µm CMOS ULSI Technology", IEEE, pp. 773-776, 1997.	
		*Ryan, J.G. et al, "Technology Challenges for Advanced Interconnects".	
		*Lowenheim, Frederick, "Electroplating", pp. 416-425, January 1979.	_
		*Patent Abstracts of Japan 04-120290, 21 April 1992.	
		*Ahn, E.C., et. al., "Adhesion Reliability of Cu-Cr Alloy Films To Polyimide," Met. Res. Soc. Symp. Proc. Vol. 427, 1996 Materials Research Society, pp. 141-145	
		*Alers, G.B. et al., "Trade-off between reliability and post-CMP defects during recrystallization anneal for copper damascene interconnects," IEEE International Reliability Physics Symposium, Orlando, Florida 2001, pp. 350-354	
		*Gladkikh, A. et. al., "Activation Energy of Electromigration in Copper Thin Film Conductor Lines," Met. Res. Soc. Symp. Proc. 1996 Materials Research Society, pp. 121-133	
		*Russell, S.W. et al., "The Effect of Copper on the Titanium-Silicon Dioxide Reaction and the Implications for Self-Encapsulating, Self-Adhering Metallization Lines," Materials Research Society Symposium Vol 260 – Advanced Metallization and Processing for Semiconductor Devices and Circuits – II (May 1992) pp 763-769	
		*Mel, Yu-Jane et al., "Thermal Stability and Interaction Between Siof and Cu Film," Met. Res. Soc. Symp. Proc. Vol 427, 1996 Materials Research Society, pp. 433-439	
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